NARAC/IMAAC SQA Activities

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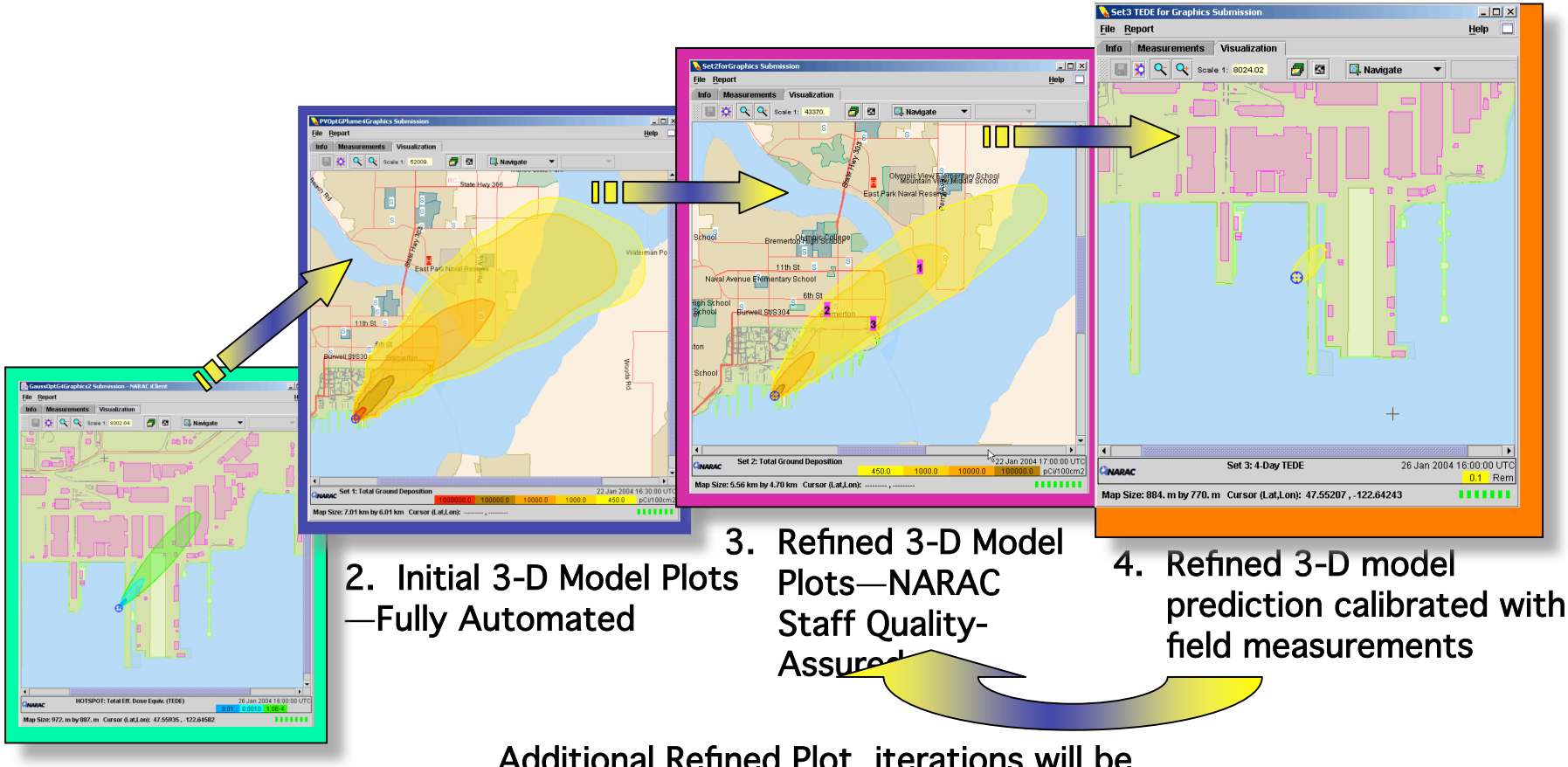
NARAC Provides Predictions for Assessing Atmospheric Hazards

- Explosive dispersal of radiological material
- Nuclear explosions
- Toxic industrial chemical spills
- Fires
- Biological agents
- Chemical agents
- Nuclear power plant accidents

What is the hazard?
Where is it going?
Who is at risk?
How do we respond?

Phased Concept of Operations



1. Initial Local Model Run quickly

2. Initial 3-D Model Plots —Fully Automated

3. Refined 3-D Model Plots—NARAC Staff Quality-Assured

4. Refined 3-D model prediction calibrated with field measurements

Additional Refined Plot iterations will be made for new measurements sets

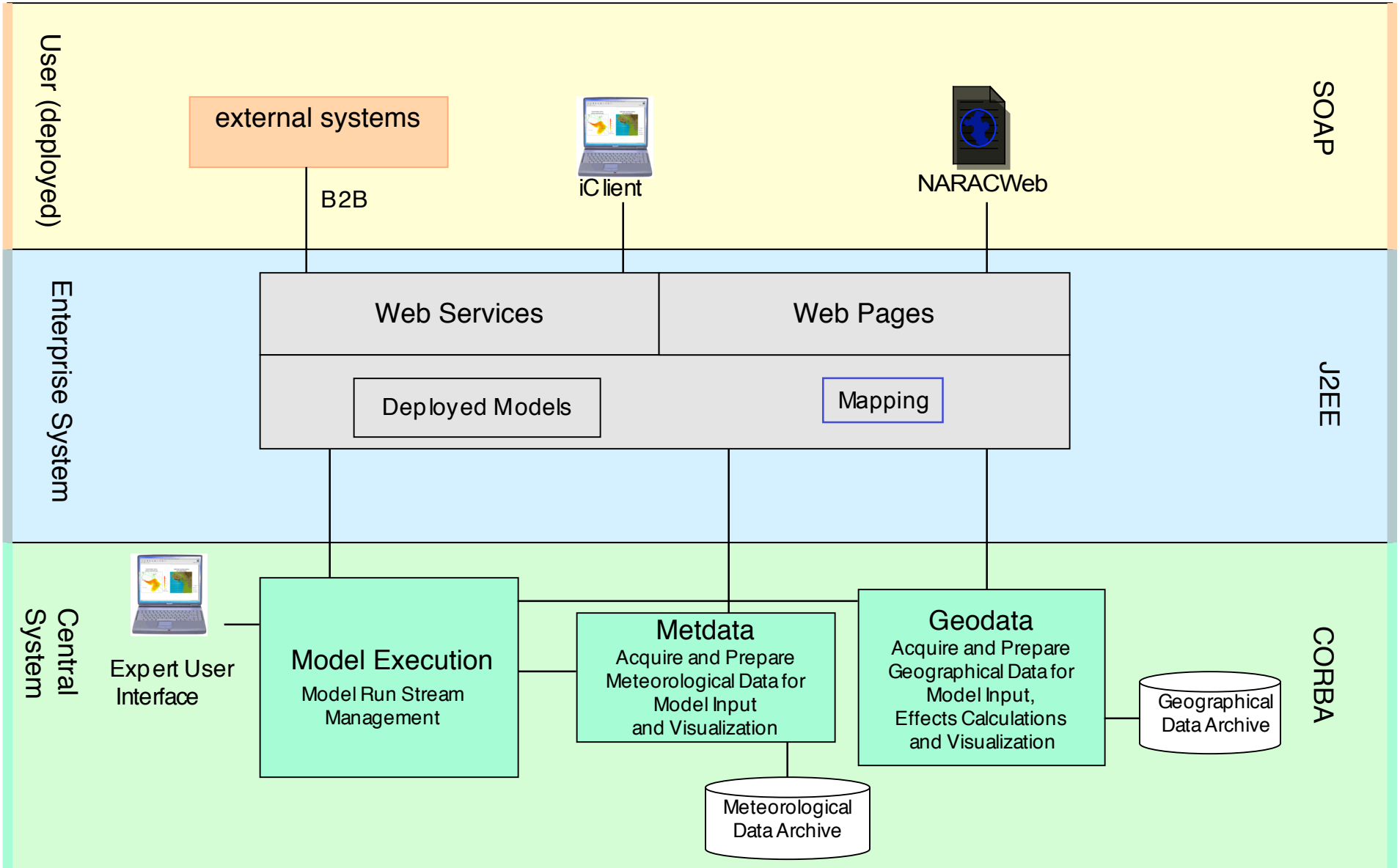
1-2 minutes | 10–15 minutes | 30-60 minutes | < 2 hours

Internal and External Models

Model	Source	Description
Hotspot	LLNL	Gaussian plume model for radioactive and nuclear material
EPICODE	LLNL	Gaussian plume model with hazardous chemical databases
BLAST	SNL	Pressure effects model for high explosives and RDDs
NUKE	SNL	Prompt dose, thermal, and overpressure effects model for nuclear weapons
KDFOC	LLNL	Gross fission products fallout effects model
COAMPS	NRL/LLNL	Mesoscale forecast model
GridGen	LLNL	Grid generation software for ADAPT/LODI using elevation data
ADAPT	LLNL	Diagnostic meteorological model
LODI	LLNL	Lagrangian stochastic particle dispersion model
BIM*	LBNL	Building interior modeling predicts indoor air concentrations
UDM*	DSTL	Empirical urban model
FEM3MP/ AUDIM*	LLNL	Multiprocessor computational fluid dynamics (CFD) building-resolving model

* Integration in progress

System Architecture



Reliable, Quality Responses

Model R&D:

- improved internal models
- integrate new models
- peer review
- configuration management
- developer testing
- benchmarking
- verification
- validation
- documentation

Computer & Software Systems:

- Software Quality Assurance
- improved data sources
- improved product presentation
- improved product delivery
- redundant data delivery pathways
- redundant hardware components
- system & network monitoring
- cyber security
- contingency planning

Operations:

- concept of operations
- daily use of system
- user testing
- internal/external training
- on-call readiness
- on-line documentation
- user group feedback
- exercises and real events
- hot washes
- assessments

SQA Work Activities

1. Software project management & quality planning
2. Software risk management
3. Software configuration management
4. Procurement and supplier management
5. Software requirements identification & management
6. Software design and implementation
7. Software safety
8. Verification & validation
9. Problem reporting and corrective action
10. Training

1. Project management

- Tools
  - Gantt charts
  - Responsibility matrices
  - Java Café
  - EXCEL
  - Bugzilla
  - Word
- Long-term architectural plan
- Formalism is gradually increasing

2. Risk Management

- **Continuous evaluation of processes**
  - **Identify risks**
- **Factors mitigating risk**

Experience (years)	0-5	5-10	10-20	20-30
people	4	5	6	3

  - **Experienced, committed staff**
  - **Co-located with operations/modeling staff**
  - **Operations staff use system daily**
  - **System & software constantly monitored**
  - **Steadily improving design skills & tools**
- **Factors increasing risk**
  - **Growing requirements**
  - **Complex system**

3. Configuration Management

- All system components are in version control
- System domains clearly separate development/production environments
  - Formal procedures for migrating integrated packages to production
- All Production domains are constantly monitored and evaluated
  - Statistics are evaluated regularly

4. Procurement & Implementation

- Use a variety of systems, packages and tools
  - EXCEL used to track acquisitions & licenses
- Selections are based on:
  - support of required capabilities
  - ease of integration
  - vendor reputation & previous experience
  - cost and deployment constraints
- All components are continuously evaluated
- Maintenance level is tuned to impact

5. Requirements Management

- **Software requirements driven from two levels**
  - **High-level requirements set by sponsors and Program Management**
  - **Detailed requirements set by internal/external users**
- **Requirements are evaluated by software staff**
- **Requirements managed in Bugzilla**

6. Design & Implementation

- Systems have been operational for 3-5 years
- Design & Implementation Approach
  - Formalism is tuned to scope of the work
  - Extensive use of patterns & refactoring
  - Effective use of improving tools
- Software integration is mostly continuous
- Review are tuned to task scope

7. Software Safety

- **Software components are continuously evaluated for their effect on operations**
  - **Critical components are redundant**
  - **Weak components are improved**
- **Safety design techniques**
  - **Extensive use of common design techniques**
  - **The exception is reduction of complexity**
  - **NARAC/IMAAC mission implies growing complexity**
  - **Challenge to manage that growth**

8. Verification & Validation

- **Verification is performed throughout the development process**
  - **Developer testing is the core of this effort**
  - **Tool-based (e.g., JUnit, WinRunner) & custom tests**
- **System validation is done by internal users focusing on new capabilities**
- **Automated tests verify existing functionality**
- **In-use tests monitor the system**
  - **Automated system checks run hourly**
  - **Failures page on-call personnel**

9. Problem Reporting

- **Bugzilla is used for problem reporting**
  - **Roles are assigned for managing Bugzilla entries.**
  - **External customers issues are entered into Bugzilla by Customer Support**
- **The coverage of the changes being tracked is improving**
- **Corrections are tracked through V&V into production**

10.Training

- Training for internal users
  - Presentations are given to the internal users
  - Web-based documentation
  - Internal users maintain a user's guide
  - Most internal user activities use the system
- Training for external users
  - Documentation on the NARAC Web page
  - Customer Support training
  - Formal classes: remote and at NARAC

Current SQA Activities

- **Focusing on LLNL SQAP**
  - Graded approach to software risk
  - Gap analysis
  - Updating NARAC SQA, Test & CM Plans
  - Improving suite of automated tests
  - Tracking requirements more precisely
- **Working with the NARAC/IMAAC Model VV&A effort**
  - Analytic tests/field experiments/operational use
  - Updating model documentation
  - Automating model V&V tests
  - Clarifying procedures for VV&A
  - Evaluation strategy for external models

Overview

- NARAC is more than a model
  - NARAC incorporates multiple models
  - NARAC provides a range of services
  - NARAC services are supported by operational scientists
- All activities in NARAC are Quality Assurance related
  - All model and system development activities address shortfalls in current capabilities
  - All operational activities are focused on providing high quality products
- Formal procedures are balanced with a flexible environment so that new capabilities can be added efficiently

Quality Requires Balanced Effort

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